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A MIGRATORY FLIGHT OF THE CALIFORNIA TORTOISE-SHELL BUTTERFLY

Additional key words: *Nymphalis californica*, Nymphalidae.

While migrations, swarms, and dense clusterings of butterflies are well documented, we believe any significant mass movement of a lepidopteran should be reported. Ultimately, published reports will form the basis for a clearer understanding of the conditions causing migrations. With such an objective, we here present field observations and data by one of us (RMK) of a unidirectional mass movement of *Nymphalis californica* (Boisduval) (Nymphalidae), the California tortoise-shell butterfly. This insect is known as a "loner" or "singleton" (Ferris, C. D. & F. M. Brown 1980, Butterflies of the Rocky Mountain States, University of Oklahoma Press, Norman, 442 pp.), but also has been recorded in enormous numbers and as migrating (Ferris & Brown, above; Howe, W. H. 1975, The butterflies of North America, Doubleday and Co., Garden City, New York, 633 pp.; Williams, C. B. 1930, The migration of butterflies, Biol. Monogr. & Manuals No. IX., Edinburgh, Oliver & Boyd, London, 473 pp.). The observations were made in California in July 1986. Specimens were identified by one of us (ENL).

On 25 July 1986 while driving E on US Interstate Hwy. 80 (I-80) at Pla-Vada, which is on the boundary between Placer and Nevada counties, a dense flight of *N. californica* was noted moving to the SW. This locality is 12 km E of the junction of I-80 and California State Hwy. 20 at an elevation of 1860 m. For a road distance of 400 m, butterflies swarmed over the highway in such numbers that they hit the automobile faster than they could be counted. So many insects both living and dead were in the air turbulence of automobiles that they constituted a distraction to motorists. The density of this moving population gradually decreased eastwardly for 1.5 km at which point no further butterflies were seen. The time was 1145 h (PDT), temperature was 19°C, and relative humidity 35% under clear skies. Wind was estimated to be at 10–12 kmh out of the N.

About 15 minutes later, more eastwardly on I-80, at the Donner Summit Rest Area, Nevada Co., located 12 km W of the junction of California State Hwy. 89 (S) and 24 km E of Pla-Vada, at an elevation of 2203 m, another flight of the species was observed. This migration was as dense as that noted above, and presumably was a part of the same population surge. The most dense section of this portion of the swarm stretched about 800 m along I-80. After the dense swarm was passed, lesser numbers were observed for 8 km E of Donner Pass to the Donner Lake Interchange (elevation ca. 2000 m). This second encounter with what we assume to be the same flying population observed earlier in the day was flying SW under weather conditions similar to those noted above.

At the Donner Summit Rest Area, 8 butterflies (2 ♂, 6 ♀) were collected from the dead in a windrow along the road. Dead butterflies numbered 20–50/m² of roadside area, and extended along I-80 for at least 3 km. No species other than *N. californica* were noted among the dead. While this estimate gives some idea of the large numbers killed, visual

estimates indicated that those in flight numbered 5–25 butterflies passing the migration corridor each second. The height of flight was 1–4 m above the ground. Repeated counts of this unidirectional flight gave similarly steady readings of the moving population. As judged from the abundance of dead insects compared with those passing in flight, this flight had been taking place for more than two h.

Three days later, on 28 July 1986, on a westward return trip, the migration was still in progress, but with fewer individuals spread over a longer distance. On that date, 10–25 butterflies could be counted in the air from anywhere within a circle. This flight extended from the Donner Lake Interchange over the Donner Pass through Norden, Soda Springs, and Cisco to the junction of I-80 and California State Hwy. 20, a distance of 42 km. Three specimens (2 ♂, 1 ♀) were collected at the W-bound Donner Summit Rest Area. Climatic conditions were clear skies, no wind, 18°C, and about 30% relative humidity. Migration was westward 1–9 m above the ground. All 11 voucher insects are in the Insect Collections of the Department of Entomology, Louisiana State University, Baton Rouge.

Later, on 1 August 1986, at the Donner Summit Rest Area, no individuals were seen in flight. Apparently the migrating population noted four to seven days earlier had moved through, and was no longer to be seen here.

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